21283/931A 3750 PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: ZHENGHE HAN et al. Serial No: 10/541,296 Filed: July 6, 2005 For: SURFACE MODIFICATION METHOD IN FABRICATING HIGH TEMPERATURE SUPER CONDUCTIVE DEVICES	Art Unit: 1793 Examiner: Paul A. Wartalowicz

APPEAL BRIEF

Honorable Commissioner of Patents & Trademarks
P.O. Box 1450
Alexandria VA 22313-1450

Dear Sir:

This is an appeal from the Final rejection dated April 13, 2009, from the Examiner of Group Art Unit 1793 rejecting the claims 1 through 13 and 15 through 18 of the above-identified patent application.

REAL PARTY IN INTEREST:

The party named in the caption of the brief is the inventor; however, the inventor has assigned all of his right, title and interest to Applied Superconductivity Research Center, Tsinghua University who is now still the owner of this invention and this patent application.

RELATED APPEALS AND INTERFERENCES:

To the best of Appellant's and Appellant's legal representatives' or Assignee's knowledge, there are no Appeals or interferences which will directly affect or be directly affected by or have any bearing on the Board's decision in this pending appeal.

STATUS OF THE CLAIMS:

A. Rejection of the Claims on Reference Grounds:

1. The Examiner has rejected the claims 1, 5, 9, 10 through 13 and 17 under 35 USC 102 as being anticipated by or, in the alternative under 35 USC 103 as being obvious over Hebard stating that Hebard teaches a process wherein a superconductor material is treated at the claimed energy and incidence angle wherein the ions are chosen from the claimed elements and an ion beam generator by the prior art of Hebard is substantially similar to plasma sputtering.

2. The Examiner has rejected the claims 1 through 4, 6, 8, 10 through 13 and 16 under 35 USC 102 as being anticipated by or, in the alternative, under 35 USC 103 as being obvious over Reade et al. stating that Reade et al. teaches a method for ion texturing superconductor devices wherein the materials to be textured include MgO, YSZ, nickel alloys, etc. wherein an ion beam at the claimed energies and claimed angles are disclosed and plasma sputtering is the same as an ion beam.

3. The Examiner has rejected the claims 1, 5, 9, 10 through 13 and 17 under 35 USC 103 as being obvious over Hebard in view of Desu et al. and Kroger stating that Hebard discloses all of the present invention except for plasma sputtering in an argon plasma; Desu et al. teaches a method of etching a thin film utilizing ion beam etching, plasma etching and sputtering etching and it is the Examiner's opinion that plasma sputtering is substantially the same thing or equivalent to sputtering etching; Kroger teaches that it is well known to treat substrate with sputter etching in an argon plasma; and it would have been obvious to one of ordinary skill in the art to modify Hebard in view of the teachings of Desu et al. and Kroger.

4. The Examiner has rejected the claims 1 through 4, 6, 8, 10 through 13 and 16 under 35 USC 103 as being obvious over Reade et al. in view of Desu et al. and Kroger stating that Reade et al. teaches a method for ion texturing superconducting devices utilizing an ion beam; Desu et al. teaches

sputtering etching which in the Examiner's opinion is the equivalent of plasma etching; Kroger teaches a method for making a superconductor wherein it is known to treat the substrate with super etching in an argon plasma; therefore, it is the Examiner's opinion that Applicant's invention would be obvious over Reade et al. in view of Desu et al. and Kroger.

5. The Examiner has rejected the claims 15 and 18 under 35 USC 103 as being obvious over Hebard in view of Chu et al. stating that Hebard discloses all of the present invention except for annealing; Chu et al. teaches a method of making superconductors wherein the superconductor is annealed after ion texturing for the purposes of restoring crystallinity; and it would have been obvious to one of ordinary skill in the art to modify Hebard in view of the teachings of Chu et al.

6. The Examiner has rejected the claim 7 under 35 USC 103 as being obvious over Reade et al. in view of Doi et al. and Shindo et al. stating that Reade et al. fails to teach texturing superconductors; Shindo et al. teaches a method of making a solar cell where it is known to texture the claimed semiconductors; Doi et al. teaches to utilize GaAs as a substrate for a superconductor; and it would have been obvious to one of ordinary skill in the art to modify Reade et al. in view of the teachings of Shindo et al. and Doi et al.

7. The Examiner has rejected the claims 15 and 18 under 35 USC 103 as being obvious over Hebard in view of Chu et al. and Desu et al. or Kroger stating that the combination thereof discloses all of Applicant's invention.

8. The Examiner has rejected the claim 7 under 35 USC 103 as being obvious over Reade et al. in view of Doi et al. and Shindo et al. and Desu et al. or Kroger stating that the combination would be all of Applicant's invention.

B. Claim 14 has been canceled without prejudice.

STATUS OF AMENDMENT:

Applicant filed a Response on July 13, 2009 to the Final Rejection dated April 13, 2009. The Response was entered and considered by the Examiner but an Advisory Action was issued on July 27, 2009 maintaining the rejection of the Final Office Action.

SUMMARY OF CLAIMED SUBJECT MATTER:

The present invention comprises a method for surface modification in the manufacture of high temperature superconducting devices as claimed by claim 1 (see page 6, lines 15-16) and a high temperature superconducting device as claimed by Appellant's claim 17 (see page 6, line 16).

In the method of claim 1 the surface of a material is bombarded with a particle beam having energy to increase the smoothness of the material surface and change the microstructure of the processed material (see page 7, lines 1-3) and generating a particle beam by a plasma sputtering device with energy in the range of 5-50,000 eV (see page 7, lines 4 and 5). In addition the material may be a metal material such as Ni, NiO, Ni alloy, Cu, Cu alloy, Ag, Ag alloy, Fe, Fe alloy, Mg and Mg alloy (see page 7, lines 12 and 13), a semiconductor material such as Si, Ge, GaAs, InP, InAs, InGaAs, CdS, GaN, InGaN, GaSb and InSb (see page 7, lines 15 and 16) and any one of an oxide material such as $SrTiO_3$, $LaAlO_3$, Y_2O_3, RuO_2, CeO_2, MgO, ZrO_2, SiO_2, Al_2O_3 and YSZ (see page 7, lines 17-18). Still further, the material may be any super conducting material such as $YBa_2Cu_3O_{7-\delta}$, $REZ_2Cu_3O_{7-\delta}$, Bi-Sr-Ca-Cu-O and TI-Ba-Ca-Cu-O (see page 7, lines 18-20).

The high temperature semiconductor device of claim 17 comprises a substrate and a high temperature superconducting film formed on the substrate (see page 7, lines 1-3 and lines 6-27). Still further, the high temperature superconducting film exhibits oblique cone topography characteristics after being bombarded with a particle beam having energy (see page 11, lines 30-32). Also, the energy of the particle beam is in the range of 5 to 50,000 electron volts (see page 7, lines 4 and 5). Still further and as claimed in claim 18 the superconducting film is annealed after being bombarded at a temperature in the range of 100 to 1,500 °C (see page 7, lines 28-30).

REFERENCES CITED:

A. Hebard (U.S. 4,966,885)

Applicant has carefully reviewed Hebard and respectfully submits that Hebard (US 4966885) discloses a method for producing an article comprising a thin film of a planar metal oxide superconductor, and the thinning the film comprises exposing the film to an ion beam. In contrast thereto, Applicants invention uses one beam from a plasma sputtering device. Still further, Applicant respectfully submits that Hebard does not disclose or suggest that the particle beam is generated by a plasma sputtering device; and the method of amended claim 1 is different from the cited Hebard and has advantages thereover. Particularly, compared with an ion beam, the plasma sputtering can be performed on a larger area of the material surface, and is much more effective to increase the smoothness of the material surface and change the microstructure or internal defect of the processed material. Compared with an ion beam gun for providing the ion beam, the plasma sputtering apparatus is simpler, can be installed more easily, is at much lower cost and is suitable for mass industrial production.

B. Reade et al. (U.S. 6,809,066)

Applicant has carefully reviewed Reade et al. and respectfully submits that Reade et al. (US 6809066) discloses a method of ion texturing a noncrystalline surface, and the exposing the noncrystalline surface to at least two ion beams to texture the noncrystalline surface. In contrast thereto, Applicants invention uses one beam from a plasma sputtering device. Still further, Applicant respectfully submits that Reade et al. does not disclose or suggest that the particle beam is generated by a plasma sputtering device; and the method of amended claim 1 is different from Reade et al. and has advantages there over. Particularly, compared with an ion beam, the plasma sputtering can be performed on a larger area of the material surface, and is much more effective to increase the smoothness of the material surface and change the microstructure or internal defect of the processed material. Compared with an ion beam gun for providing the ion beam, the plasma sputtering apparatus is simpler, can be installed more easily, is at much lower cost and is suitable for mass industrial production.

C. Desu et al. (U.S. 5,873,977)

Appellant has carefully reviewed Desu et al. and respectfully submits that Desu et al. teaches a method of etching a film utilizing sputtering etching to remove material (see column 3, lines 42-53). However, sputtering etching removes surface material and is not the equivalent of the plasma sputtering of Applicant's invention because the main purpose of plasma sputtering is to increase the smoothness of the material surface and change the microstructure or internal defect of the processed material rather than to mainly remove material from the surface, which is the main purpose of sputtering etching.

D. Kroger (U.S. 4,536,414)

Appellant's careful review of Kroger indicates that as admitted by the Examiner it teaches sputter etching but in an argon plasma. Again, Appellant respectfully submits that sputter etching is not the same as plasma sputtering or the equivalent thereof since its main purpose is to remove material (as is admitted by Desu et al. at column 3, lines 42-53) and does not function in the manner of the plasma sputtering of Applicant's invention.

E. Chu et al. (U.S. 6,251,835)

In addition, Appellant has carefully reviewed Chu et al. and respectfully submits that while it may teach a method of making superconductors, it teaches a method of first smoothing the HTS surface by gas cluster ion beams (GCIB) bombardment followed by annealing in a partial pressure of oxygen to re-grow the damaged surface layer. However, the ion beam technique utilized to generate the GCIB (column 1, line 7) is different from the plasma sputtering in Appellant's invention as mentioned above. Accordingly, Appellant respectfully submits that Chu et al. does not function in the manner of Appellant's invention.

F. Doi et al. (U.S. 6,316,391)

Still further Appellant has reviewed Doi et al. and respectfully submits that Doi et al. teaches superconductive substrates that have a curved structure, but does not teach a manufacturing or modification thereof. Also, Appellant respectfully submits that Doi et al. does not teach that GaAs can act as a substrate for high temperature superconductors. Still further, Appellant respectfully submits that Doi et al.. does not function in the manner of the

plasma sputtering of Appellant's invention.

G. <u>Shindo et al. (U.S. 5,738,731)</u>

Appellant has reviewed Shindo and respectfully submits that it relates to the production of solar cells which are not a semiconductor in the sense of Appellant's or Reade's invention. Still further Shindo uses a plurality of beams and not one beam as in Appellant's invention.

<u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL:</u>

A. The claims 1, 5, 9, 10 through 13, and 17 are rejected under 35 USC 102 as being anticipated by or, in the alternative, under 35 USC 103 as being obvious over Hebard and it is Appellant's position that Hebard does not disclose each and every element of Appellant's invention as claimed and/or all of the elements of the claimed invention are not obvious from the teachings of Hebard.

B. The claims 1 through 4, 6, 8, 10 through 13 and 16 are rejected under 35 USC 102 as being anticipated by or, in the alternative, under 35 USC 103 as being obvious over Reade et al. and it is the Appellant's position that all of the elements of the claimed invention are neither shown by or suggested by Reade et al.

C. The claims 1, 5, 9 10 through 13 and 17 are rejected under 35 USC 103 as being obvious over Hebard in view of Desu et al. and Kroger and it is Appellant's position that the combination suggested by the Examiner is not only not Appellant's invention but also would not have been suggested to one of ordinary skill in the art.

D. The claims 1 through 4, 6, 8, 10 through 13 and 16 are rejected under 35 USC 103 as being obvious over Reade et al. in view of Desu et al. or Kroger and it is Appellant's position that the combination suggested by the Examiner is not only not Appellant's invention but also would not have been suggested to one of ordinary skill in the art.

E. Claims 15 and 16 are rejected under 35 USC 103 as being obvious over Hebard in view of Chu et al. and it is Appellant's position that the combination suggested by the Examiner is not Appellant's invention.

F. Claim 7 is rejected under 35 USC 103 as being obvious over Reade et al. in view of Doi et al. and Shindo et al. and it is Appellant's position that the combination suggested by the

Examiner is not only not Appellant's invention but also would not have been suggested to one of ordinary skill in the art.

G. The Examiner has rejected the claims 15 and 18 under 35 USC 103 as being obvious over Hebard in view of Chu et al. and Desu et al. or Kroger and it is Appellant's position that the combination suggested by the Examiner is not only not Appellant's invention but also would not have been suggested to one of ordinary skill in the art.

H. The claim 7 is rejected under 35 USC 103 as being obvious over Reade et al. in view of Doi et al. and Shindo et al. and Desu et al. or Kroger and it is Appellant's position that the combination suggested by the Examiner is not only not Appellant's invention but also would not have been suggested to one of ordinary skill in the art.

ARGUMENT:

A. The rejection of claims 1, 5, 9, 10 through 13 and 17 under 35 USC 102 as being anticipated by or, in the alternative, under 35 USC 103 as being obvious over Hebard

It is the Examiner's position that there is no structural difference between the particle beam of the prior art and the particle beam of Appellant's invention, namely plasma sputtering. However, Appellant respectfully submits that there are basic differences which are generally acknowledged by science and technology researchers. A detailed description of these two different concepts can be found in the two books in this research field namely: "Thin film processes", by John L. Vossen and Werner Kern, New York, Academic Press, 1978, and "Glow discharge processes", by Brian Chapman, New York, Wiley, 1980 (copies of which are enclosed herewith).

Appellant respectfully submits that in Hebard, cited by the Examiner, the ion beams are produced by ion guns, also referred to as ion sources. However, in Appellant's invention, plasma sputtering is carried out by plasma sputtering systems. Appellant' respectfully submits that these two techniques, ion beam and plasma sputtering, are widely used for both sputtering and depositions. The energetic particles generated by the ion guns or plasma sputtering systems can knock atoms out of the surface of the target. While it can be concluded that sputtering and sputtering deposition have similar theory and systems with merely different purposes, Appellant respectfully submits that either sputtering or sputtering

deposition, the two techniques, ion beam and plasma sputtering, are always strictly distinguished.

In particular, the plasma sputtering technique is usually carried out in a vacuum system in which discharge occurs. In a conventional plasma sputtering system, a DC voltage is utilized, the material to be sputtered is made into a target which becomes the cathode of an electric circuit and has a negative voltage applied to it. The particles generated from the discharge gas are accelerated towards the target to produce the sputtering (see pages 187 through 188 of "Glow Discharge Processes" by Brian Chapman and pages 12 through 14 of "Thin Film Processes by Vossen and Kern). For some materials, an AC voltage is required to accelerate the particles (see page 195 of "Glow Discharge Processes by Chapman and pages 27 through 29 of "Thin Film Processes" by Vossen and Kern). Still further, the magnetic field effects are used quite a lot in sputtering systems, which provides advantages in sputtering rate, extendibility of operating range and so on. As a result, Appellant respectfully submits that different types of magnetically enhanced plasma sputtering systems, such as cylindrical magnetron sputtering, circular magnetron sputtering, plainer magnetron sputtering, etc. are utilized. (see page260-270 in the book of "Glow discharge processes" by Brian Chapman and page76-170 in the book of "Thin film processes" by Vossen and Kern) Still further, plasma sputtering usually can effect a rather large area.

As can be seen from the references to Vossen, Kern and Chapman, when sputtering or sputter deposition is introduced, ion beam systems are always separate from the plasma sputtering system since the energetic particles are generated by special equipment, namely ion guns, in an ion beam system. In particular, Appellant respectfully submits that the ion gun is a device in which gas ions are produced, omitted, accelerated and focused as a rather narrow beam. Acceleration takes place mainly in the extracted region since this is usually where the greatest potential drop exists. The focus system of the ion sources can adjust the divergence of the ion beam. It can be concluded therefore that there are quite significant differences in the generation of the energetic particles between ion beam systems and plasma sputtering systems (see pages 175 through 189 in "Thin Film Processes"). Appellant respectfully submits that the ion beam sputtering usually treats smaller areas relative to plasma sputtering, depending on the diameter of the ion gun. The particles of the ion beam are better parallel focused and non-energetic while requiring a more expensive

facility. Also, ion guns are relatively expensive and require lower pressure in a vacuum facility and some gases, such as oxygen should be avoided to protect the ion gun. Therefore, compared with an ion beam gun for providing the ion beam, the plasma sputtering apparatus is simpler, can be installed more easily, is at much lower cost and is suitable for mass industrial production.

In view of the above, therefore, Appellant respectfully submits that ion beam systems are not the same or a substitute for plasma sputtering systems.

Therefore, Appellant respectfully submits that Hebard does not show or suggest the use of a particle beam generated by a plasma sputtering device for surface modification in manufacturing high temperature superconducting devices. Therefore, Appellant respectfully submits that this critical element of Appellant's invention is neither shown nor suggested by Hebard and the claims 1, 5, 9, 10 through 13 and 17 are not anticipated or obvious thereover.

B. <u>The rejection of claims 1 through 4, 6, 8, 10 through 13 and 16 under 35 USC 102 as being anticipated by or, in the alternative, under 35 USC 103 as being obvious over Reade et al.</u>

Appellant respectfully submits that Reade et al., similarly to Hebard discloses the use of an ion gun. Accordingly, Appellant respectfully submits that for all the same reasons as discussed above relative to Hebard, Appellant respectfully submits that a particle beam from a plasma sputtering system is not shown or suggested by Reade et al. therefore, Appellant respectfully submits that Reade et al. does not show or suggest each and every element of Appellant's invention and the claims 1 through 4, 6, 8, 10 through 13 and 16 are not anticipated by nor obvious over Reade et al.

C. <u>The rejection of the claims 1, 5, 9, 10 through 13 and 17 under 35 USC 103 as being obvious over Hebard in view of Desu et al. or Kroger</u>

In reply to this rejection, Appellant would like to incorporate by reference his comments above concerning Hebard. In addition, Appellant has carefully reviewed Desu et al. and Kroger and respectfully submits that each teaches plasma etching. Appellant respectfully submits that plasma etching is a special conception of a process that is carried out

to take away a layer of a multi-layer structure or to make a layer thinner (see pages 244-252 of "Glow Discharge Processes" by Chapman). In contrast thereto, in Appellant's invention, while the plasma sputtering may result in some small amount of material being removed from the surface, this is not the main purpose thereof. The plasma sputtering process is to make the surface smoother, or to change the material structure, or to reduce defects in the material and Appellant respectfully submits that none of these can be achieved utilizing a plasma or sputtering etching process. Still further, Appellant respectfully submits that in Desu et al., plasma etching is used to cause the etching of the thin film of ferroelectric material. Also, Appellant respectfully submits that in Kroger the sputtering etching results in a substantial improvement of the sub-gap current-voltage characteristic of the super conductive tunnel junction device (see page 4, column 4, line 1). Accordingly, Appellant respectfully submits that the plasma etching or sputtering etching of either Kroger or Desu et al. is different from the plasma sputtering in Appellant's invention.

In view of the above, Appellant respectfully submits that none of Hebard, Desu et al. or Kroger show, suggest or teach the utilization of a particle beam generated by a plasma sputtering device for surface modification in a manufacturing of high temperature superconductive devices. Therefore, Appellant respectfully submits that the claims 1, 5, 9, 10 through 13 and 17 are not obvious over Hebard in view of Desu et al. or Kroger.

D. <u>The rejection of claims 1 through 4, 6, 8, 10 through 13 and 16 as being obvious over Reade et al. in view of Desu et al. or Kroger</u>

Appellant would like to first incorporate by reference his comments above concerning Appellant's invention, Reade et al., Desu et al. and Kroger. Based upon Appellant's arguments above, Appellant respectfully submits that neither Reade et al., nor Desu et al. nor Kroger disclose the use of a particle beam generated by a plasma sputtering device for surface modification in manufacturing high temperature superconductive devices. Accordingly, Appellant respectfully submits that the combination suggested by the Examiner is not Appellant's invention.

E. <u>The rejection of claim 7 under 35 USC 103 as being obvious over Reade et al. in view of Doi et al. and Shindo et al.</u>

Appellant would like to incorporate by reference his comments above concerning Reade et al. and Appellant's invention. In addition, Appellant has carefully reviewed Shindo et al. and respectfully submits that it relates to the production of solar cells and has nothing to do with superconductors. Still further, Appellant has carefully reviewed Doi et al. and respectfully submits that neither Shindo et al. nor Doi et al. teach the use of a particle beam generated by a plasma sputtering device for surface modification in manufacturing high temperature superconducting devices. Accordingly, Appellant respectfully submits that neither Reade et al., Doi et al. or Shindo et al. show or suggest the use of a particle beam generated by a plasma sputtering device for surface modification in manufacturing superconducting devices as claimed by Appellant's claim 7.

F. The rejection of claims 15 and 18 under 35 USC 103 as being obvious over Hebard in view of Chu et al.

Appellant would like to incorporate by reference his comments above concerning Appellant's invention and Hebard. In addition, Appellant has carefully reviewed Chu et al. and respectfully submits that an ion beam technique is utilized to generate the GCID (see column 1, line 57.) which is different from the plasma sputtering of Appellant's invention as discussed above. Therefore Appellant respectfully submits that Chu et al. does not show or suggest the use of a particle beam generator by a plasma sputtering device for surface modification in manufacturing high temperature superconducting devices. Therefore, Appellant respectfully submits that neither Hebard nor Chu et al. disclose the use of a plasma beam generated by a plasma sputtering device for surface modification in manufacturing high temperature superconducting devices. As a result, Appellant respectfully submits that the combination suggested by the Examiner is not Appellant's invention as claimed by claims 15 and 18.

G. The rejection of the claims 15 and 18 under 35 USC 103 as being obvious over Hebard in view of Chu et al. and Desu et al. or Kroger

Appellant would like to incorporate by reference his comments above concerning Appellant's invention, Hebard, Chu et al., Desu et al. and Kroger. In addition, Appellant would like to point out that the art cited by the Examiner either does not disclose

the use of a particle beam generated by a plasma sputtering device for surface modification in manufacturing high temperature superconducting devices or is from a divergent art which could not be looked at or considered by one of ordinary skill in the art. Accordingly, Appellant respectfully submits that the elements of claims 15 and 18 would not only not be shown or suggested by the combination of Hebard, Chu et al. Desu et al. or Kroger, but also the combination of Hebard, Chu et al., Desu et al. or Kroger would not have been suggested to one of ordinary skill in the art.

H. <u>The rejection of claim 7 under 35 USC 103 as being obvious over Reade et al. in view of Doi et al. and Shindo et al. and Desu et al. or Kroger</u>

Appellant would like to incorporate by reference his comments concerning Reade et al., Doi et al., Shindo et al., Desu et al. or Kroger and respectfully submits that none of this art cited by the Examiner discloses the use of a particle beam generated by a plasma sputtering device for surface modification in manufacturing high temperature superconducting devices. Therefore, Appellant respectfully submits that the combination suggested by the Examiner is not only not Appellant's invention but also would not have been suggested to one of ordinary skill in the art.

CONCLUSION:

The finally rejected claims 1 through 13 and 15 through 18 of Appellant's application are respectfully submitted as clearly allowable for the reasons set forth below:

1. Claims 1 through 13 and 15 through 18 are not obvious nor anticipated by the cited art.

2. The allowance of claims 1 through 13 and 15 through 18 is earnestly solicited.

3. An oral hearing is not requested.

4. Pursuant to the telephone conversation with Mr. Pierce of the Board of Patent Appeals, submitted herewith are three (3) copies of the Appeal Brief and one (1) copy of each of "Thin film processes: by John L. Vossen and Werner Kern and "Glow discharge processes" by Brian Chapman.

5. Please charge the fee in the amount of $270.00 (Fee Code: 2402) for filing the Appeal Brief to QUINN EMANUEL DEPOSIT ACCOUNT NO. 50-4367.

Please charge any additional costs incurred by or in order to implement this Appeal Brief or required for any requests for extensions of time to QUINN EMANUEL DEPOSIT ACCOUNT NO. 50-4367.

Respectfully submitted,

By: ____________________
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Name

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CLAIMS APPENDIX:

Claim 1: A method for surface modification in manufacturing high temperature superconducting device, comprising the step of:

bombarding a surface of a preformed material with a particle beam having energy to increase the smoothness of the material surface and change the microstructure or internal defect of the processed material;

wherein the particle beam is generated by a plasma sputtering device; and the energy of the particle beam is in the range of 5-50000eV.

Claim 2: The method according to claim 1, wherein the material is MgO.

Claim 3: The method according to claim 1, wherein the material is CeO_2.

Claim 4: The method according to claim 1, wherein the material is a cold rolled Ni substrate.

Claim 5: The method according to claim 1, wherein the material is YBCO.

Claim 6: The method according to claim 1, wherein the material is any one of following metal materials: Ni, NiO, Ni alloy, Cu, Cu alloy, Ag, Ag alloy, Fe, Fe alloy, Mg and Mg alloy, purities of the alloy materials are more than 99% and alloying constituents of the metal alloys are at least 0.01wt.%.

Claim 7: The method according to claim 1, wherein the material is any one of following semiconductor materials: Si, Ge, GaAs, InP, InAs, InGaAs, CdS, GaN, InGaN, GaSb and InSb.

Claim 8: The method according to claim 1, wherein the material is any one of following oxide materials: $SrTiO_3$, $LaAlO_3$, Y_2O_3, RuO_2, CeO_2, MgO, ZrO_2, SiO_2, Al_2O_3 and yttria-stabilized zirconia (YSZ).

Claim 9: The method according to claim 1, wherein the material is any one of the following superconducting materials: $YBa_2Cu_3O_{7-\delta}$ ($0<\delta<0.5$), $REZ_2Cu_3O_{7-\delta}$ (RE is a rare earth element Z is an alkaline rare earth element $0<\delta<0.5$), Bi-Sr-Ca-Cu-O, TI-Ba-Ca-Cu-O.

Claim 10: The method according to claim 1, wherein the modification of the material is bulk, external or internal.

Claim 11: The method according to claim 1, wherein the surface of the material is monocrystalline, amorphous or polycrystalline structure.

Claim 12: The method according to claim 1, wherein the surface of the material is polished or unpolished.

Claim 13: The method according to claim 1, wherein the material is a substrate, a transition layer, a superconducting layer preformed in the process of manufacturing the superconducting device, or any combination of them.

Claim 14 (canceled).

Claim 15: The method according to claim 1, further comprising annealing the material bombarded with the particle beam, wherein the annealing temperature is in the range of 100-1500°C.

Claim 16: The method according to claim 6, wherein alloying constituents of the metal alloys are at least 0.1wt.%.

Claim 17: A high temperature superconducting device, comprising:

a substrate; and

a high temperature superconducting film formed on the substrate,

wherein the high temperature superconducting film exhibits oblique cone topography characteristic after being bombarded with a particle beam having energy, wherein

the particle beam is generated by a plasma sputtering device, and the energy of the particle beam is in the range of 5-50000eV.

Claim 18: The high temperature superconducting device according to claim 17, wherein the high temperature superconducting film is annealed after being bombarded with the particle beam, and the annealing temperature is in the range of 100-1500°C.

EVIDENCE APPENDIX

1 "Thin Film Processes" by John L. Vossen and Werner Kern, and

2 "Glow Discharge Processes" by Brian Chapman

RELATED PROCEEDING APPENDIX (none)